The "scientific investment" by cardiac surgery

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Before it is over, 2006 will be an interesting, and perhaps exciting, year in cardiothoracic surgery. On the one hand, after years of clinical and financial commitment to improving quality of care through scientific analysis of the practices undertaken in adult cardiac surgery, we as a specialty are poised to benefit if our clinical metrics for quality and performance evaluation are adopted. Alternatively, to meet the mandate of "applicability across all providers," we may be relegated to a few data metrics collected through administrative data mechanisms, effectively rendering these scientific efforts to the sidelines.[E1]

Both of these scenarios relate to the pay-for-performance (P4P) movement in medicine, which hits the ground running in 2006.[E2] The issue at hand is not whether P4P in some form is going to happen, but rather whether the "scientific investment" of the past 15 years by cardiothoracic surgeons worldwide, and the results obtained, warrant consideration beyond "kudos" in this ongoing dynamic.

This "scientific investment" has been nothing short of remarkable, beginning with the efforts of the Northern New England Cardiovascular Study Group, the formation of the Veterans Administration and Society of Thoracic Surgeons National Databases, and the development of the Parsonnet risk-evaluation system. In Europe, similar national database efforts took place, and the EuroSCORE risk-evaluation system was developed and used widely across the continent. In the United States, voluntary provider-led regional efforts at quality evaluation commenced in the face of public reporting of regional outcomes of data from the New York State Registry. Numerous large local data systems have been developed and reported on as well. During the past 7 years the Society for Thoracic Surgeons National Cardiac Database has developed into the national platform for quality evaluation and improvement by scientific testing of continuous quality improvement and validation of this platform at a national level. These large, mostly observational efforts have characterized the everyday practice of adult cardiac surgery far more accurately than any randomized clinical trial, while benchmarking the incorporation of important and accurate clinical trial data into everyday clinical practice.

In 2004, stakeholders in the United States reviewed data from this "scientific investment" and documented remarkable declines in risk-adjusted mortality and morbidity in all adult cardiac surgery procedures, as well as adoption of processes documented to improve quality of care by current evidence-based medicine. This in part resulted in the 21 metrics selected and approved in 2005 by the 4 Councils and Board of the National Quality Forum for the evaluation of performance and quality of cardiac surgical programs in the United States. This metric set illustrates that a prerequisite for accurate performance and quality assessment is the use of both process AND risk-adjusted outcome measures in this evaluation. Outcomes are assessed by hierarchic, multivariable logistic regression techniques believed to be most representative of accurate clinical risk assessment. In the National Quality Forum Cardiac Surgery Performance Measures, set structural measures were deliberately included as well, completing the Donabedian triad of quality measurement.

In this edition of the *Journal*, Nilsson and colleagues[1] use a new application of an old technique to assess risk in cardiac surgery. Artificial neural networks (ANNs) have variously been applied to large observational datasets in medicine, a number of which have been in cardiac surgery. The results have mostly been variable compared with more conventional methods of risk adjustment, including Bayesian models, logistic regression models, and, more recently, hierarchic modeling, which is thought to more accurately account for clustering of observations within provid-

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ers. Within the limitations of comparison of risk models across different datasets, Nilsson and colleagues' analysis does not provide sufficient evidence to abandon these current and more accepted risk-modeling techniques.

As pointed out by the authors, however, one prospective theoretic advantage of the ANN approach is that, in analyzing the large dataset necessary for model development, it would be possible to create a single model metric encompassing all adult cardiac surgery cases. This in turn could become the benchmark for profiling an individual provider's performance within his or her overall clinical practice, rather than breaking the performance metrics down by procedure (coronary artery bypass graft, valve, valve + coronary artery bypass graft).

The limitations inherent in this analysis are informative as well. First, models of all types perform optimally when applied to the datasets from which the model was developed; model performance (and therefore accuracy of risk evaluation) will vary somewhat when the ANN model is applied to the 1995 EuroSCORE dataset model, as was the case here. Second, the use of the 1995 EuroSCORE dataset presents limitations in extrapolation of these findings to current clinical practice; today's practice of cardiac surgery is more complex with higher-risk patients overall, and all risk models perform least well at the extremes (low and high) of predicted risk. Thus, application of the ANN methodology to a contemporary dataset, and in particular the high-risk end of that dataset, would need to be carefully evaluated and tested before use in clinical practice or provider evaluation. Third, most surgeons do not consider preoperative patient risk to be equivalent across all adult procedure categories. Although a comprehensive model is of interest, when it is being proposed as a predictive model, additional contemporary data on the predictive power within procedure category groups will be needed before incorporation into clinical practice. Only if the ANN model can in addition predict risk more accurately within the procedure subsets will there be renewed interest in this modeling technique.

If this article does not describe a new, improved methodology for risk assessment, why, then, is it important? Its principal value lies in the fact that it illustrates and emphasizes the continued "scientific investment" effort on the part of cardiac surgery. At its most granular level, 3 points can be made: (1) This article and editorial are discussing the merits of new and different risk-adjustment modeling techniques for cardiac surgery because the optimal risk model for outcomes assessment does not exist; (2) this voluntary, provider-driven investigation into quality and performance represents an important contribution to moving this "scientific investment" forward; and (3) the commitment to this degree of "scientific investment" does not currently exist elsewhere in medicine. At the 10,000 foot level, it is this same degree of "scientific investment" that has led to the contributions made within this specialty to Continuous Quality Improvement in medicine, which are equally unprecedented compared with other remaining provider groups.

The willingness to voluntarily embrace, from both a leadership and financial perspective, this "scientific investment" by the practice of cardiac surgery has been a hallmark of the international effort by the specialty. In this year of 2006, cardiac surgery might finally see if there is any real return on this investment, in both practice and politics.

In practice, it is clear that the information generated from this "scientific investment" is not being communicated correctly, if at all, to the majority of patients presenting with ischemic heart disease before undergoing percutaneous coronary interventions.[E3] This is particularly important in patients with 3-vessel disease, in whom the mortality and morbidity from the procedures (coronary artery bypass grafting vs percutaneous coronary intervention) are equivalent, the long-term 3-year mortality outcomes favor coronary artery bypass grafting by up to 43%,[E4] and the long-term financial and clinical effectiveness argument for elective multivessel or left main percutaneous coronary intervention simply cannot be constructed.[E5]

In politics, it seems that defining decisions about the P4P will be made in 2006. Thus, it is of paramount importance that this "scientific investment" be represented as critical for success at all levels of provider evaluation and for all types of providers. The remarkable improvement in quality of care delivered by cardiac surgeons during the past 15 years is a direct result of this "scientific investment." The return on this investment has directly accrued to the patients who undergo cardiac surgery. If this "scientific investment" paradigm is abandoned as P4P moves forward, patients who undergo cardiac surgery will irrevocably see their return from this investment disappear. In other areas of medicine, this return has yet to be realized.

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